COMMERCIAL STANDARD CS104-63

WARM-AIR FURNACES EQUIPPED WITH VAPORIZING-TYPE OIL BURNERS

(Effective August 1, 1963)

1. PURPOSE

1.1 This standard is provided as a basis for the quality and performance of warm-air furnaces equipped with vaporizing-type oil burners, for the guidance of manufacturers, distributors, installers, contractors and purchasers.

2. SCOPE

2.1 This standard applies to warm-air furnaces equipped with vaporizing-type oil burners and arranged with either gravity or forced-air circulation. It does not include floor furnaces or wall furnaces. This standard includes the following sections:

3. DEFINITIONS

3.1 Warm-air furnace is a device designed to supply heat through a system of ducts with air as the heating medium, and in which the heat, generated by combustion is transferred to the air by conduction through heat exchange surfaces. Such a furnace consists essentially of a heat exchanger surrounded by a casing.

3.1.1 Heat exchanger includes the combustion chamber and any auxiliary heat transfer surfaces surrounded by the casing.

3.1.2 Combustion chamber is the enclosure in which fuel or gaseous derivatives of fuels are burned.

3.1.3 Radiator in a warm-air furnace is an additional enclosure within the casing, connected between the combustion chamber and the flue to form auxiliary heat transfer surface.

3.1.4 Casing is the envelope, usually of metal, which encloses and forms a passage around the heat exchanger for the stream of air being heated. It is provided with openings to receive air from the return ducts or from the heated space and to deliver warmed air to the supply ducts connected to it.

3.1.5 Bonnet is the part of the casing which forms a plenum chamber from which the supply ducts receive warmed air.

3.2 Gravity furnace and heating system is one in which air circulation is caused by the tendency of heated air to rise, due to its lowered density relative to the surrounding air.

3.3 Forced-air furnace is one equipped with a fan or blower, usually electrically driven, to maintain a flow of air through the furnace and duct system.

3.4 Vaporizing-type oil burner is a device for the combustion of fuel oil, consisting of an oil-vaporizing bowl or other receptacle to which the liquid fuel may be fed in controllable quantities, the heat of combustion being used to vaporize the fuel, with provisions for admitting air and mixing it with the oil vapor in combustible proportions.

3.5 Standard air is air weighing 0.075 lb./cu.ft. (This weight corresponds to dry air at 70° F., or air with 50% relative humidity at a dry-bulb temperature of 68° F. when the barometric pressure is 29.92 in. mercury). Specific heat is taken to be 0.243 B.t.u./lb.

3.6 Air delivery (c.f.m.) is the quantity in cubic feet of air per minute, corrected to standard conditions, which passes through the furnace unit and is delivered at the bonnet.

3.7 External static pressure of a furnace is the static pressure available for circulating air through the connected supply and return duct systems. In essence, it is the pressure generated by the fan or blower less the resistance of the filter and casing. For purposes of this standard, external static pressure is measured in inches water gage, as described in paragraph 7.3.4.

3.8 Inlet duct temperature (T_1) is the average temperature of the air entering the inlet of a forced-air furnace and is to be measured by a thermocouple not heavier than No. 24 AWG located centrally in the inlet test duct as described in paragraph 7.2.9.

3.9 Outlet air temperature (T_2) is the average temperature of the air discharged from the furnace outlet duct or ducts and is to be measured by a thermocouple grid as indicated in paragraph 7.2.6 for forced-air furnaces or paragraph 8.2.1.1 for gravity furnaces.

3.10 Air temperature rise ($T_2 - T_1$) is the difference between the average outlet air temperature and the average inlet duct air temperature with the furnace operating at steady state test conditions as specified in paragraph 7.5.

3.11 Flue-gas temperature (T_3) is the average temperature of the flue gases measured at point (1) indicated in figure 2, and expressed in degrees Fahrenheit.

3.12 Room temperature (T_4) is the temperature adjacent to the furnace and is to be measured by a bead-type iron-constantan thermocouple not heavier than No. 24 AWG, suitably shielded from direct radiation and located centrally 24 inches in front of the furnace at an elevation of 24 inches above the base of the furnace. For a horizontal furnace, the thermocouple shall be located 24 inches horizontally from the center point.

3.13 Oil input is the rate at which oil is supplied to the furnace in gallons per hour.

3.14 Calorific value of the fuel is the high heating value of the fuel used for the tests, expressed in B.t.u. per pound.

3.15 Heat input is the total gross heating value of the oil supplied to the furnace, expressed in B.t.u. per hour.

3.16 Bonnet capacity is the heat delivered at the bonnet of the furnace, expressed in B.t.u. per hour.

3.17 Bonnet efficiency is the percentage of heat input which is delivered at the bonnet of the furnace.

3.18 Gross output is the heat, expressed in B.t.u. per hour, available for space heating, including the heat transfer through the casing, plenum chamber, and that part of the stack between the furnace and the point of measurement of flue gas temperature (see figure 2). The gross output is equal to the heat input minus the flue gas losses, expressed in B.t.u. per hour.

3.19 Stack loss is that part of the heat input which escapes in the flue gases. It is indicated in the stack loss chart, figure 5.

3.20 Manufacturer, for the purpose of this standard, shall be the company or organization which evidences its responsibility to the purchaser by (1) permanently affixing its name, address, or nationally registered trademark or trade name to the furnace; and (2) printing its name, address, or nationally registered trademark or trade name on the instructions.

3.21 Listed is the term applied to products which are included in a list published by a nationally recognized testing agency that is qualified and equipped for experimental testing, maintains an adequate periodic inspection of current production of listed products, and whose listing states that the product complies with nationally recognized safety requirements or has been tested and found safe for use in specified manner. (The Underwriters' Laboratories, Inc. is such a nationally recognized testing agency.)

3.22 Electrical equipment includes all controls, wiring, conduit, conduit fittings, switches, relays or other devices which serve as electrical conductors, which route a conductor, or which provide an electrical switching, transforming, protecting or driving function.

3.23 Confined space is a space, such as an alcove or closet, having a volume less than 12 times the volume of the appliance as determined by the casing dimensions (including blower compartment and burner vestibule). In calculating the room volume, ceiling height in excess of 8 feet shall not be included.[1]

Note: Copies of test data sheets referred to in this standard are available from Office of Commodity Standards.

3.24 Locations requiring special precautions include installations in a confined space (par. 3.23); attic installations and installations with clearance less than those specified in the standard of the National Board of Fire Underwriters, Pamphlet 31 and subsequent revisions; and other installations which, in the opinion of the Standing Committee, require special precautions.

4. GENERAL REQUIREMENTS

4.1 Safety. - The furnace and burner shall meet the safety requirements of the Underwriters' Laboratories, Inc., and the National Board of Fire Underwriters. Presence on the furnace of the Label of Underwriters' Laboratories, Inc., shall be accepted as evidence of compliance with these safety requirements for the application for which the equipment is listed.

4.2 Durability. - The design and construction of the furnace and burner shall be such as to insure its durability in service as outlined in Section 5.

4.3 Dependability. - The furnace and burner shall be capable of functioning uniformly and reliably when installed and adjusted in accordance with the manufacturer's instructions.

4.4 Noise. - The furnace and burner shall be as free as is commercially practicable from disturbing combustion and/or mechanical noises and radio interference.

4.5 Furnace testing for rating and performance. - Each furnace model shall be tested and rated according to this Commercial Standard, as outlined in Sections 6, 7, 8, and 9.

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[1] This definition shall apply until such time that a definition for "confined space" or "space large in comparison to an appliance" is adopted by nationally recognized governing authorities such as N.B.F.U., at which time such adopted definition shall govern.

4.5.1 Furnace testing for safety. - In order to conform to the requirements of this standard, all furnaces shall also meet the safety requirements of Underwriters' Laboratories, Inc., Standard for Oil-Fired Central Furnaces, UL Subject 727, October 1957 and subsequent revisions. (The Underwriters' Laboratories, Inc., label attached to the furnace shall be accepted as evidence of compliance with the requirements of Subject 727.)

4.6 Efficiency. - The furnace shall be capable of meeting the minimum efficiency requirements outlined in Section 6.

4.7 Operating instructions. - Each furnace shall be accompanied by a complete set of instructions covering essential points with respect to selection of fuel, installation, space requirements, operation, and upkeep.

5. FURNACE DESIGN AND CONSTRUCTION

5.1 The general construction of a warm-air furnace shall be such that all parts are well fitted and that it will not show signs of becoming warped, bent, broken, or otherwise damaged during the initial test, installation, or during any of the tests specified, so as to prevent its compliance with any of these requirements. Whether specifically covered by the various provisions of these requirements or not, the construction shall be in accordance with reasonable concepts of safety, substantiality and durability.

5.2 Every part of the furnace shall be secure against displacement, and shall be constructed so as to maintain a fixed relationship between essential parts under normal and reasonable conditions of handling and usage to assure continued compliance with these requirements.

5.3 All furnaces shall be of such construction that no part of the products of combustion will become mixed with the discharged warm air.

5.4 Outer casing shall be constructed of steel or other suitable material and be of such design that it is not readily damaged or dented in shipment or use.

5.5 Oil burners shall be of the vaporizing type, constructed of steel, or other suitable material of equal resistance to heat, corrosion and fuel leakage.

5.6 Combustion chambers radiating drums and/or other surfaces exposed to the direct heat of the burner flame shall be constructed of sheet steel not lighter than 18 gage[2] or other suitable material. Combustion chambers shall be fitted with doors or equivalent means for permitting access to interior surfaces as required for lighting, cleaning, servicing, etc.

5.7 Radiators or economizers, when used, shall be constructed of steel, not lighter than 18 gage, or other suitable material, and the construction shall be such as to insure strength, rigidity, and durability. The total area of the flue passages shall never be less than that of a 6-in. diameter pipe (28 square inches).

5.8 Flue collar shall be constructed of cast iron, or of sheet steel of suitable thickness, and shall be rigidly attached at the flue outlet of the furnace. It shall afford convenient suitable means for attaching the flue pipe securely to the flue collar.

5.9 Finish protection. - Where necessary, the casing shall be protected by baffles, inner liner, or insulating materials installed inside to shield it from the heat exchanger in order to prevent damage to the exterior finish or to the casing itself by overheating.

5.10 Barometric draft regulator, or other adequate means for controlling the effect of chimney draft on burner operation, which meets applicable requirements of the Underwriters' Laboratories, Inc., shall be furnished with each furnace. It may be furnished integral

[2] Gage refers to manufacturers standard gage.

with the furnace or with instructions for its installation.

5.11 Electrical equipment. - All electrical equipment and wiring (excluding that which uses 30 volts or less and is not a part of a safety circuit and excluding electric motors) supplied on or with the furnace shall be listed as defined in paragraph 3.21.

5.11.1 Motors. - All motors, motor protection, motor wiring, location, and temperature limits shall conform to the requirements of the National Electric Code and Underwriters' Laboratories, Inc.

5.11.1.1 Motor protection devices listed by recognized testing organizations, and used in accordance with the terms of such listings, shall be deemed to be in compliance with these requirements without further tests.

5.11.2 Means shall be provided for lubricating motor and blower or fan bearings, and where lubricant must be added, such means shall be readily accessible. The removal of screws in access panels shall be considered acceptable under this provision. Motor, blower, or fan may employ permanently lubricated bearings.

5.11.3 Instructions for lubrication of motor and blower or fan bearings shall be permanently affixed to or imprinted upon the fan or blower housing or on surfaces adjacent to the means of access. Instructions shall designate the proper type and grade of lubricants to be used.

5.11.4 Bearings of motors, blowers, or fans shall be of a type suitable for the temperature to which the equipment is subjected in normal operation.

5.11.5 On belt-driven blowers or fans, means for adjusting belt tension shall be provided and shall be readily accessible.

5.11.6 Motors using belt drives shall be supplied with adjustable pulleys.

5.12 Filters. - Disposable-type filters supplied with forced-air type furnaces, tested for compliance at air temperature rises of 85° F. and 115° F., shall have not less than 3.92 sq. in. of filter area per 1,000 B.t.u./ hr of input rating based on nominal filter area.[3] On forced-air type furnaces tested for compliance at an air temperature rise of 60° F. disposable-type filters shall have not less than 5.55 sq. in. of filter area per 1,000 B.t.u./hr. of input rating based on nominal filter area.

For the purpose of this requirement, the nominal area of the filters taken to the next larger integral inch shall be employed in computing velocity.

The air velocity through permanent-type filters shall not exceed the filter manufacturer's recommended air velocity, based on the air temperature rise at which the furnace is tested for compliance with this standard.

Filters of forced-air central furnaces shall be so located that the temperature of any portion of the filter does not exceed 90° F. above inlet-air temperature under conditions of normal operation.

5.13 Air temperature limit controls

5.13.1 All air temperature limit controls shall be of the automatic reset type and may be adjustable or non-adjustable. If adjustable, they must be provided with a fixed stop which will limit the outlet air temperature as specified in paragraphs 5.13.2, 5.13.3, and 5.13.4. A fixed stop is one that cannot be changed without the use of special tools.

[3] The figure of 3.92 sq. in. is equivalent to 300 ft./min. at a 90° F. rise, while the 5.55 sq. in. equals 3.92 X 85/60 sq. in.

If an auxiliary limit control is supplied, it may be of the manual reset type but must be an integral part of the furnace in all cases.

5.13.2 Gravity warm air furnaces shall be provided with a limit control which will limit the outlet air temperature to a maximum of 250° F. or less, but not lower than 180° F., and may be supplied separately from the furnace.

5.13.3 Upflow type forced-air furnaces, tested at the optional air temperature rise of 60° F., shall be provided with a limit control which will limit the outlet air temperature to a maximum of 165° F., but not lower than 140° F. When tested at the standard air temperature rise of 85° F., they shall be provided with a limit control which will limit the outlet air temperature to a maximum of 200° F., but not lower than 175° F. When tested at the optional air temperature rise of 115° F., they shall be provided with a limit control which will limit the outlet air temperature to a maximum of 250° F., but not lower than 200° F. In all cases the limit control may be supplied separately from the furnace.

5.13.4 Downflow and horizontal type forced-air furnaces, tested at the optional air temperature rise of 60° F., shall be provided with a limit control which will limit the outlet air temperature to a maximum of 165° F., but not lower than 140° F. When tested at the standard air temperature rise of 85° F., they shall be provided with a limit control which will limit the outlet air temperature to a maximum of 200° F., but not lower than 175° F. When tested at the optional air temperature rise of 115° F., they shall also be provided with a limit control which will limit the outlet air temperature to a maximum of 200° F., but not lower than 190° F. In all cases the limit control must be supplied as an integral part of the furnace.

5.13.5 Where a temperature limit control is supplied separately for the furnace, complete instructions for its proper installation shall be supplied by the manufacturer.

6. PERFORMANCE

6.1 The furnace shall be capable of meeting the minimum performance requirements given in paragraphs 6.2 to 6.5, when it is tested as outlined in Sections 7 or 8, whichever is applicable.

6.2 Heating capacity. - The furnace shall be capable of delivering heat as rated by the manufacturer when it is tested as outlined in Sections 7 or 8, whichever is applicable.

6.3 Downflow or horizontal furnace, adjusted for operation according to paragraph 7.5, shall be operated from a cold start until the blower becomes operative or a limit control functions to shut off the burner. Neither the limit control nor an auxiliary limit control (if used) shall function to shut off the burner until the fan control functions to start the blower. In the case of a cycling limit control, the above shall apply only after the first cycle.

6.4 During normal operation of downflow or horizontal furnaces from a cold start, controls shall operate to prevent abnormal air temperature under conditions of reversed air flow through the furnace. The maximum temperature indicated by any of the three thermocouples (see paragraph 7.2.10) at the return-air opening of the furnace shall not exceed 90° F. above room temperature prior to the functioning of the fan control to circulate air in the normal manner, when tested with the special duct described in paragraph 7.2.10.1 or 7.2.10.2, whichever is applicable.

6.5 Air delivery. - The blower in a forced-air furnace shall deliver sufficient air so that the air temperature rise through the furnace shall not exceed 85° F. when tested at rated capacity under standard conditions, or not less than the air temperature rise selected by the manufacturer for optional tests, as described in paragraph 7.2 and Section 9.

6.6 Operating efficiency. - When tested at manufacturer's recommended draft and at full

rated output, as outlined in Sections 7 and 8, furnaces shall be capable of operating at the following efficiencies:

(a) 75% bonnet efficiency for forced-air furnaces.

(b) 70% bonnet efficiency for gravity furnaces.

7. TEST CODE FOR FORCED-AIR FURNACES

7.1 The heat input, bonnet capacity, bonnet efficiency, and air delivery shall be determined in accordance with the following method or an equivalent method and recorded on the approved test data sheets.

7.2 Arrangement of testing apparatus for forced-air furnaces. - (See figures 1, 2, and 3.)

7.2.1 A plenum conforming to the warm-air outlet regularly supplied with the furnace, and of sufficient height to accommodate any controls that may be placed in same, shall be provided and shall include a test duct at right angles to the plenum at its outlet end. (See figure 1.)

7.2.2 The test duct shall be rectangular and in no case shall the aspect ratio exceed 4 to 1.

7.2.3 The size of the standard test duct shall be calculated for an air velocity of approximately 900 feet per minute of standard air (0.075 lbs. per cu. ft.) with a 90° F. temperature rise through the furnace and based on an output equivalent to 75 percent of the rated input (Btuh) of the furnace. Specific heat is to be taken to be 0.243 B.t.u. per lb. of air.

7.2.4 A formula derived from the above where the outlet duct area is expressed in square inches is as follows:

$$\text{Area} = (\text{B.t.u. per hour input}) \times 0.00122$$

7.2.5 In the case of optional furnace ratings where tests are conducted at a specified air-temperature rise of 60° F. or 115° F. this standard test duct may be used.

7.2.6 Outlet air temperature shall be measured by means of 9 bead-type thermocouples, having wire diameters not exceeding No. 24 AWG, wired in parallel and located in the test duct as specified below:

(a) The test duct cross section shall be divided into 3 equal horizontal and 3 equal vertical areas, with a thermocouple centrally located in each of the 9 areas thus obtained. The length of all thermocouple leads shall be equal before paralleling.

(b) The thermocouple grid shall be located in the test duct as close as possible to the plenum without any single thermocouple being able to receive direct radiation from any part of the heating surface, or within 6 inches downstream of this location.

7.2.7 The end of the test duct shall be a minimum of 6 in. downstream from the thermocouple grid location.

7.2.8 All performance and rating tests shall be conducted with the air filter (s) removed in order to insure uniform determination of external static pressure obtained by symmetrically restricting the outlet of the test duct.

7.2.9 All forced-air furnaces shall be provided with an inlet-duct for test purposes, attached to and preferably of the same dimensions as the return air opening of the furnace fan compartment and shall be at least 12 inches in length. A rectangular elbow is to be

substituted for the straight duct in all cases where the thermocouple for measuring inlet air temperature (T_1) could receive direct radiation from any part of the heating surface.

7.2.9.1 The outlet and inlet air ducts shall always be positioned at least 90° apart.

All tests on forced warm-air furnaces, except as otherwise specified, shall be conducted at an 85° F. temperature rise. A tolerance of ± 2° is permitted for convenience of adjustment by the testing agency. The specifications for the outlet air plenum with test duct are such as to provide a practical maximum air velocity through the test duct to assure that the nine- thermocouple grid provides a single, instantaneous, and accurate reading for determining outlet air temperature under all test conditions.

7.2.10 Downflow and horizontal furnaces. -

7.2.10.1 To determine whether or not reversed air flow produces excessive temperatures in a downflow furnace, attach a rectangular duct, the same size as a vertical return air opening of the furnace and extend it vertically so that the distance from the floor line to the top of the duct is not less than 7 1/2 feet. Air temperature shall be measured by three individual bead-type thermocouples having wire diameters not exceeding No. 24 AWG, located in the plane of the return air opening of the furnace casing on a horizontal centerline parallel to the blower axis. One thermocouple shall be located 1 inch from one side of the opening; one at the center; and the other 1 inch from the opposite side.

7.2.10.2 To determine whether or not reversed air flow produces excessive temperatures in a horizontal furnace, attach a rectangular duct, the same size as the inlet-air opening of the furnace, to the return-air inlet and extend it vertically to a distance of 6 feet above the top of the return-air opening of the furnace. Air temperature shall be measured by three individual bead-type thermocouples, having wire diameters not exceeding No. 24 AWG, located in the plane of the return-air (inlet-air) connection of the furnace on a horizontal line, one-third of the distance below the top of the return air opening of the furnace. One thermocouple shall be located 1 inch from one side of the opening; one at the center; and the other 1 inch from the opposite side of the opening.

7.2.10.3 The limit control shall be adjusted to the maximum temperature setting as specified under paragraph 5.13. The fan switch (if adjustable) shall be adjusted as specified by the manufacturer in his instructions, or it may be provided with a fixed stop to limit this temperature setting. The specified setting or the location of a fixed stop on the fan switch shall be such as to permit the furnace to operate so as to conform with all other requirements of this standard.

7.2.11 There shall be no opening between the furnace and the point where the flue-gas sample is taken or the flue-gas temperature measured; if a barometric damper is incorporated in the furnace, it shall be sealed during all tests.

7.2.12 Source of draft. - The draft may be produced by a chimney, or by a fan or other arrangement for providing induced draft.

7.2.13 Soot and dust. - The heating surfaces, furnace, flues, and chimney shall be clean and free from soot and dust at the beginning of the test.

7.3 Instruments and measuring apparatus. -

7.3.1 Weighing scales or other suitable instruments for determining fuel consumption, draft gages, pressure gages, barometer, thermocouples, potentiometer, and a smoke meter shall be provided.

7.3.2 Fuel meter. - Scales capable of readings to 0.01 lb., or a burette capable of the same resultant accuracy, shall be provided for measuring fuel oil.

7.3.3 Draft gages. - Measurements shall be made with gages graduated to 0.01 in. of

water or less. Gages shall be checked for zero reading at the beginning and the end of each test. A draft gage capable of readings to ± 0.0025-in. water column shall be used for purpose of checking.

7.3.4 Pressure gage. - An inclined draft gage shall be connected where shown in figure 1 to determine the external static pressure. Measurements shall be made with a gage graduated to 0.01 in. of water or less. For checking this gage, a draft gage capable of readings to ± 0.0025 in. shall be used. The static pressure connection shall consist of a 1/4 in. diameter nipple soldered to the surface of the duct and centered over a hole 0.040 in. in diameter drilled through the sheet metal duct. The inner surface of the duct shall be free from burrs and irregularities.

7.3.5 Fan measurements. - A wattmeter may be placed in the electric circuit of the fan motor to measure the power consumption. A revolution counter or other equal instrument may be provided to measure the speed of the fan for the information of the testing laboratory and the manufacturer.

7.3.6 Temperature measurement. - Suitable thermocouples and a potentiometer shall be provided for all temperature measurements during the laboratory tests.

7.3.7 Flue gas analysis. - The flue gas sample for analysis shall be taken as indicated in figures 2 and 3. Gas analysis apparatus, preferably of the Orsat type, capable of determining CO_2 with an accuracy of plus or minus one-fourth of one percent or better, and a suitable method of measuring CO, such as that based on the dry-chemical colorimetric type of reaction shall be provided. (See footnote to paragraph 7.5 (e).)

7.3.8 Smoke meter. - A Shell-Bacharach or equivalent instrument shall be provided for smoke determination.

SHELL-BACHARACH FILTER PAPER METHOD FOR DETERMINING SMOKE DENSITY IN FLUE GASES:

7.3.9 Outline of method. - The filter paper method for determining smoke density in flue gases involves passing through filter paper, as specified below, a test flue-gas volume of 2,250 (± 100) cubic inches (standard conditions) for each square inch effective surface area of filter paper used. Sampling device shall be of such construction that total travel of flue-gas sample from flue to filter paper shall not exceed 16 inches. Suitable laboratory and portable field service equipments are illustrated in figures 6 and 7.

The resultant test smoke spot on the test filter paper is measured to establish its color density by visual matching with a smoke scale, as specified below, consisting of 10 graded numbered spots ranging from white to black. The closest match determines the gross smoke spot number of the test spot. When making this comparison, test filter paper must be backed by a white surface having absolute surface reflectance of not less than 75 percent.

Net smoke spot number shall be determined by deducting from the gross smoke spot number, the smoke spot number obtained by matching the spot obtained on filter paper through which has been drawn a sample of air from the space from which the combustion air is being supplied, using the same equipment, filter paper, test volume, and evaluation as were used in measuring gross smoke spot number. In case of disagreement on the visual net or gross test spot number evaluation, the photometric smoke spot number evaluation described below shall be employed.

7.3.10 Specification of filter paper. - Test filter paper is required, made from white filter paper stock having absolute surface reflectance of between 82.5 percent and 87.5 percent determined by photometric measurement. When making this reflectance measurement, filter paper must be backed by a white surface having absolute surface reflectance of not less than 75 percent. When clean air is drawn through clean filter paper at a rate of 1,125 cubic inches (60° F., 1 atmosphere pressure) per square inch effective surface area

of filter paper per minute, the pressure drop across the filter paper should fall between limits of 0.5 inch and 2.5 inches of mercury.

7.3.11 Specifications of smoke scale. - The smoke scale (figure 8) required for use with the filter paper method consists of 11 spots consecutively numbered from 0 to 10[4] ranging in equal photometric steps from white through neutral shades of gray to black, imprinted or otherwise processed on white paper or plastic stock having an absolute surface reflectance of between 82.5 and 87.5 percent, determined photometrically. The smoke scale spot number is defined as the reduction in reflected incident light (due to existence of soot) divided by 10. Thus, the first (perfectly white) spot, which is the color of the unimprinted scale, will be number 0, since there will be in the case of this spot no reduction in reflected incident light directed thereon. The last spot, however, is very dark, reflecting none of the incident light directed thereon; thus in this case the reduction in reflected incident light is 100 percent, which, divided by 10, gives to this darkest spot the number 10. Intermediate spot numbers are similarly established. Limit of permissible reflectance variation of any smoke scale spot is not to exceed ± 3 percent relative reflectance. Such smoke scales are sufficiently accurate for field use and for many laboratory smoke testing applications. However, specially calibrated scales, known as certified smoke scales, sometimes will be required (as in the case of Underwriters' Laboratories, Inc., burner performance rating tests), for which the specifications are given in the following paragraph.)

A certified smoke scale is obtained by individually calibrating each smoke spot of a normal smoke scale. The normal smoke scale is first mounted in the light beam of a suitable type of reflectance photometer, and the photometer is adjusted to read 100 percent when the light beam is directed at spot number 0. Each imprinted smoke scale spot is then in turn exposed to the photometer light beam and the percentage reduction in reflected light due to the imprinting measured. Each smoke scale spot number is then established by the percentage reduction in incident light divided by 10. These precise smoke spot numbers expressed in decimal values to the nearest tenth shall then be furnished with the suitably identified scale.

Where the smoke scale is protected with a plastic or transparent cover, the construction employed shall be such that when the smoke spot on the filter paper is viewed for matching with the numbered spots on the smoke scale, both shall be visible through the same thickness and number of sheets of transparent protective cover.

7.3.12 Photometric test spot number evaluation. - The human factor involved in visually comparing filter paper test spots with smoke scale spots can be eliminated by resort to direct use of a suitable photometer for evaluating test spots. To make this direct photometric test spot evaluation, the following procedure shall be employed: Filter paper backed by material having absolute surface reflectance of not less than 75 percent shall be mounted in the lightbeam of a suitable type of reflectance photometer with beam focused on a clean, unused surface of the filter paper adjacent to the smoke spot, and the photometer adjusted to read 100 percent reflectance in terms of the light reflected from this clean surface. Test smoke spot on filter paper shall then be exposed to the photometer light beam and the percentage reduction in reflected light due to the presence of smoke particles on and in the filter paper shall be measured. Gross smoke spot number shall be defined as equal to this percentage reduction in reflected light divided by 10. Net smoke spot number shall be determined by deducting from the gross smoke spot number the smoke spot number determined by measurement of a filter paper through which has been drawn a duplicate sample of air from the space from which combustion air is being supplied, using the same equipment, filter paper, test volume, and calculation as were used in measuring gross smoke spot number.

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[4] It is permissible to omit the number 10 spot from the smoke meter scale, since the number 9 spot is sufficiently dark for fuel oil combustion applications.

7.3.13 Specification of photometer. - The photometer to be employed for direct test spot number evaluation shall be of the electrically operated reflectance type employing a barrier layer cell, fitted with special means to accommodate filter paper test disks. It is to be furnished complete with green tristimulus filter and with reflectance standards of approximately 20, 40, 60, and 80 percent absolute reflectance, to permit photometer readings between 10 and 90 percent relative reflectance (relative to clean filter paper) to be made within ± 2 percent accuracy.

7.3.14 Availability of smoke meters, filter paper, scales, and photometers. - Suitable instruments and accessories for both field and laboratory testing are commercially available. Inquiry regarding current sources of supply should be directed to Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois.

7.4 Calorific value of fuel

7.4.1 The API gravity of the fuel shall be determined with a hydrometer according to ASTM Designation D287, and recorded on the test report.

7.4.2 The fuel used for furnace rating tests shall be of the heaviest grade recommended by the manufacturer but not heavier than the heaviest grade for which the burner has been listed for safety (see paragraph 3.21), and shall be assumed to have a gross heating value as given in table 1:

Table 1. Calorific values for fuel oil [1]

Degrees API at 60° F.	Density, lb/gal.	Btu/lb.	Btu/gal.
24	7.587	19,190	145,600
25	7.538	19,230	145,000
26	7.490	19,270	144,300
27	7.443	19,310	143,700
28	7.396	19,350	143,100
29	7.350	19,380	142,500
30	7.305	19,420	141,800
31	7.260	19,450	141,200
32	7.215	19,490	140,600
33	7.171	19,520	140,000
34	7.128	19,560	139,400
35	7.085	19,590	138,800
36	7.043	19,620	138,200
37	7.011	19,650	137,600
38	6.960	19,680	137,000
39	6.920	19,720	136,400
40	6.879	19,750	135,800
41	6.839	19,780	135,200
42	6.799	19,810	134,700

[1] These figures are from Miscellaneous Publication M97 (table 6) of the National Bureau of Standards.

7.4.3 Table 2 gives API gravity of fuel corrected to 60° F.

Table 2. Correction to standard API gravity at 60° F.[1]

Observed temperature of oil	Observed gravity (degrees API)									
	24	25	26	27	28	29	30	31	32	33
°F										
50	24.6	25.6	26.6	27.6	28.7	29.7	30.7	31.7	32.7	33.7
60	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0
70	23.4	24.4	25.4	26.4	27.4	28.3	29.3	30.3	31.3	32.3
80	22.8	23.8	24.8	25.7	26.7	27.7	28.7	29.6	30.6	31.6
90	22.2	23.2	24.2	25.1	26.1	27.1	28.0	29.0	30.0	30.9
100	21.6	22.6	23.6	24.5	25.5	26.5	27.4	28.4	29.3	30.3

Observed temperature of oil	34	35	36	37	38	39	40	41	42
°F									
50	34.7	35.7	36.7	37.7	38.8	39.8	40.8	41.8	42.8
60	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
70	33.3	34.3	35.3	36.2	37.2	38.2	39.2	40.2	41.2
80	32.6	33.6	34.6	35.5	36.5	37.5	38.4	39.4	40.4
90	31.9	32.9	33.8	34.8	35.8	36.7	37.7	38.7	39.6
100	31.3	32.2	33.2	34.1	35.1	36.1	37.0	37.9	38.9

[1] The above figures are from National Standard Petroleum Oil Table, Circular C410 (March 4, 1936), of the National Bureau of Standards.

7.5 Test conditions. - The tests shall be run under the following conditions:

(a) The furnace shall be operated at the manufacturer's specified Btu per hour input rating, ± 2 percent, until steady-state conditions of air temperature, fuel-flow rate, and flue-gas temperature have been established. Smoke in the flue gases shall not exceed that corresponding to the No. 6 smoke on the Shell-Bacharach scale or equivalent.

(b) The average draft at the furnace outlet during the test shall be that recommended by the manufacturer for high fire operation, but not to exceed 0.06-in. water column for natural draft, not to exceed 0.04-in. for mechanical-draft burners, and not less than 0.02-in. water column for either. The maximum fluctuation in draft during the test shall not exceed plus or minus 0.005-in. water column.

(c) The air delivery shall be such that the temperature of the outlet air exceeds the temperature of the inlet air by 85° F. (± 2° F.) except for special furnaces tested under Section 9.

(d) The observed flue-gas temperature at maximum-output rating shall not be less than 300° F. nor more than 880° F. above laboratory temperature for natural-draft burners, nor more than 780° F. above laboratory temperature for mechanical-draft burners.

(e) Unburned fuel gases shall not occur in the flue products in sufficient quantities, to be measurable by suitable methods of gas analysis, as CO in excess of 0.1 percent by volume. A suitable method of gas analysis for measuring percent carbon monoxide in the

flue products is that based on the dry-chemical colorimetric type of reaction. Instruments employing this principle are commercially available and inquiry regarding current sources of supply should be directed to Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois.

7.5.1 Furnaces shall be tested with total external static pressures not less than those indicated in table 3.

Table 3. Relation of furnace input to external static pressure for test purposes.

Input to furnace	External static pressure [1] [2] [3] [4] [5]
B.t.u./hr.	in.
80,000 and under	0.12
Over 80,000 to 100,000	.15
Over 100,000 to 200,000	.20
Over 200,000 to 375,000	.25
Over 375,000	.30

[1] In the case of a combination unit in which a specific refrigeration coil is supplied, the unit shall be tested with the coil in place, and the external static pressure applied shall be not less than that specified above, with the addition of 0.05-in. water column for a dry coil.

[2] If the furnace is optionally tested at a 60° F. air temperature rise, the external static pressure shall be not less than twice the static pressures listed in the table above, except that it must not be less than 0.3-in. water column

[3] At the option of the manufacturer, any furnace tested at a standard or an optional air temperature rise may be tested at external static pressures in excess of those specified above, except that the excess shall be an integral multiple of 0.05-in. water column and shall be shown on the rating plate or on a permanent plate adjacent thereto.

[4] For furnaces tested without air filters in place, add 0.08-in. water column to these values for furnaces tested at 60° F. or 85° F. air temperature rise, or 0.05-in. water column for furnaces tested at 115° F. air temperature rise.

[5] This is the net pressure loss of the duct system (external to the casing), as defined in paragraph 3.7.

7.6 Determination of bonnet capacities. -

7.6.1 Bonnet capacities shall be determined by deducting the sum of the casing loss and stack loss from the heat input (See figure 5.)

7.6.2 For forced warm-air furnaces under test, the bonnet capacity in B.t.u. per hour shall equal or exceed 0.75 times input.

7.6.3 For gravity warm-air furnaces under test, the bonnet capacity in B.t.u. per hour shall equal or exceed 0.70 times input.

7.6.4 In determining the bonnet capacity of a furnace in accordance with this standard, the casing loss of a forced-air furnace may be assumed to be 2% and that of a gravity furnace to be 5%. The manufacturer, however, may, at his option, conduct a casing loss test if he thinks it advisable in order to meet the operating efficiencies specified in paragraph 6.6 by substituting the percentage loss determined by such test for the assumed percentages. The test shall be conducted and recorded in accordance with the attached "test data sheets". (See paragraph 4.5.)

7.6.5 Air delivery. - The air delivery of the furnace in cubic feet per minute may be

determined either by actual test or by means of the formula:

$$\text{Air delivery, c.f.m.} = \frac{0.9145 \times \text{Bonnet capacity, (B.t.u.)}}{T_2 - T_1}$$

in which bonnet capacity is determined in accordance with paragraph 7.6.1

T_1 = average inlet-air temperature, °F.
T_2 = average outlet-air temperature, °F.

7.6.6 The heat input shall be determined by multiplying the pounds of fuel used per hour by the B.t.u. per pound as obtained from table 1 (par. 7.4.2), using the gravity corrections specified in table 2 (par. 7.4.3). If volumetric method of oil-flow rate in gallons per hour is used, determine heat input by multiplying the observed gallons-per-hour rate, corrected to 60° F., by the B.t.u. per gallon from table 1 (par. 7.4.2), using the gravity corrections specified in table 2 (par. 7.4.3) to correct observed oil-flow rate to oil-flow rate at 60° F.

$$\text{Gal./hr. at 60° F.} = \frac{\text{Observed gal./hr.}}{0.00042\ (\text{observed oil temp.} - 60) + 1}$$

8. TEST CODE FOR GRAVITY FURNACES

8.1 The heat input, bonnet capacity, bonnet efficiency, and air delivery shall be determined in accordance with the following method.

8.2 Arrangement of testing apparatus for gravity furnaces. (See figure 4.)

8.2.1 The manufacturer shall provide for test purposes a vertical test plenum or extended casing, either rectangular or round, depending on the shape of either the casing or plenum collar, to which horizontal ducts, either rectangular or round, shall be attached, as specified in figure 4 and according to the tabulated input rating below:

Input rating in B.t.u./hr	Number of duct openings required
30,000 - 185,000	2
185,001 - 277,000	3
277,001 - or more	4

8.2.1.1 The vertical test plenum shall be of such dimensions that, when placed on the furnace, the centerline of the duct outlets are 8 feet above floor level. Ducts 3 feet in length shall be attached to the outlets. The test plenum and ducts may, at the option of the manufacturer, be insulated with a blanket of insulation 2 inches thick, having a thermal conductivity (K) factor of approximately 0.27 B.t.u. per hour per square foot per inch thickness per degree F. difference between the opposite surfaces, or insulation material of equivalent heat transmission factor (U). (Glass wool is suitable for this purpose.)

The total area of the horizontal ducts shall be determined by the following formula:

$$A = \frac{0.75q}{111}$$

where

A = area of all duct outlets, sq. in.
0.75 = assumed efficiency
q = manufacturer's input rating, B.t.u./hr.
111 = National Warm Air Heating & Air Conditioning Association's recommended heat-carrying capacity of first-floor leaders, B.t.u./ (sq.in.) (hr.)

Where this area results in a diameter or rectangular dimensions other than integral inches, the next largest integral inch size may be used. In no case shall the aspect ratio exceed two to one.

For round ducts, five thermocouples are to be used, with one junction at the center and the other four placed 90° apart at points two-thirds the distance from the center to the perimeter of the duct.

For rectangular ducts, six thermocouples are to be used, located at the center of six areas obtained by dividing the test duct cross-section into three equal horizontal areas which are divided into two equal vertical areas.

8.2.1.2 The area of the return air opening shall be equal to the area of the outlets. When two return air openings are used, they shall be equal in their dimensions, with a total area not to exceed the total area of the outlets. Location of return air openings are to be specified by the manufacturer for the purpose of test.

8.2.1.3 Furnaces equipped with integral bonnets or plenums shall be furnished with horizontal warm air outlet ducts, 3 feet in length, the total cross-sectional area of which shall not exceed the area determined by the above formula. The temperature of the inlet air shall be taken as room temperature, determined as specified in paragraph 3.12.

8.2.2 The provisions of paragraphs 7.2.11, 7.2.12, and 7.2.13 shall apply to the testing of gravity furnaces.

8.3 Instruments and measuring apparatus. - The instruments and measuring apparatus used shall be the same as specified in paragraphs 7.3.1, 7.3.2, 7.3.3, 7.3.6, 7.3.7, 7.3.8, 7.3.9, 7.3.10, 7.3.11, 7.3.12, 7.3.13, and 7.3.14.

8.4 Calorific value of fuel. - The calorific value of the fuel shall be determined as specified in paragraphs 7.4.1, 7.4.2, and 7.4.3.

8.5 Test conditions. - The tests shall be run under the following conditions:

(a) The furnace shall be operated at the manufacturer's specified Btu per hour input rating, ± 2 percent, until steady-state conditions of air temperature, fuel flow rate, and flue-gas temperature have been established. The amount of smoke in the flue gases shall not exceed that corresponding to the #6 smoke on the Shell-Bacharach scale or equivalent.

(b) The average draft during the test shall be that recommended by the manufacturer for high fire operation, but not to exceed 0.06-in. water column and not less than 0.02-in. water column. The maximum fluctuation in draft during the test shall not exceed plus or minus 0.005-in. water column.

(c) The temperature of the air at any outlet shall not exceed room temperature by more than 130° F.

(d) The observed flue-gas temperature at the maximum-output rating shall be not less than 300° F., nor more than 920° F. above laboratory temperature.

(e) Unburned gases shall not occur in the flue gases in sufficient quantities to be measurable by recognized methods of gas analysis as CO in excess of 0.1 percent by volume. A suitable method of gas analysis for measuring percent carbon monoxide in the flue products is that based on the dry-chemical colorimetric type of reaction. Instruments employing this principle are commercially available and inquiry regarding current sources of supply should be directed to Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois.

8.6 Observations during test. - After steady-state conditions have been established, the actual rating test shall be started and continued for at least 1 hour. The observations

shall be recorded on the "test data sheets". (See Note *, pages 28 and 29).

8.7 Determination of bonnet capacities. - (See par. 7.6.)

9. PUBLICATION OF FURNACE RATINGS

9.1 The nominal (catalog) bonnet capacities of furnaces meeting the requirements of this Commercial Standard shall be determined by the formulas:

(1) Forced warm-air furnaces:
Nominal (catalog or nameplate) bonnet capacity in B.t.u./hr. = 0.80 X input during rating tests.

(2) Gravity warm-air furnaces:
Nominal (catalog or nameplate) bonnet capacity in B.t.u./hr. = 0.75 X input during rating tests.

9.2 Data provided in the manufacturer's printed literature for each model or size of warm-air furnace tested in accordance with this Commercial Standard shall comply with the provisions of this standard.

9.3 Standard furnace rating. - A forced-air furnace designed for operation at an allowable temperature rise varying from 70° F. to 105° F. shall have all tests conducted at an air temperature rise of 85° F. A tolerance of ± 2° F. is permitted for convenience of test adjustment. A rating obtained for these conditions shall be termed a standard furnace rating.

9.4 Optional furnace ratings . -

9.4.1 If the furnace is to be certified for operation at an allowable air temperature rise ranging from 50° F. to 70° F., the tests which would normally be conducted at an 85° F. rise shall be conducted at a 60° F. rise. A tolerance of ± 2° F. is permitted for convenience of test adjustment.

9.4.2 If the furnace is to be certified for operation at an allowable air temperature rise ranging from 50° F. to 105° F., it shall be tested for compliance with all of the rating and performance provisions of this standard at an air temperature rise of 85° F. and shall also be tested for blower capacity only for operation at a 60° F. rise.

9.4.3 If the furnace is to be certified for operation at an allowable air temperature rise ranging from 100° F. to 130° F. or from 100° F. to 120° F. (See par. 5.13.3) the tests which would normally be conducted at an 85° F. rise shall be conducted at a 115° F. rise. A tolerance of ± 2°F is permitted for convenience of test adjustment.

9.4.4 If the furnace is to be certified for operation at an allowable air temperature rise ranging from 70° F. to 130° F. (120° F.) or from 50° F. to 130° F. (120°F.), it shall be tested for compliance with all of the rating and performance provisions of this standard at an air temperature rise of 115° F. and shall also be tested for blower capacity only for operation at an 85° F. rise or a 60° F. rise respectively.

9.4.5 Any forced-air furnace certified by the manufacturer for an increased range of allowable air temperature rise involving additional tests for blower capacity, may be provided with one label and one model number covering this increased range as long as the design, construction and dimensions of the furnace and blower are not changed. In the case of belt driven blowers, a change in blower pulleys or motor size is permissible as long as it is adequately covered in the manufacturer's instructions. In the case of direct-drive blowers a change only in motor horsepower/and or r.p.m range is permissible as long as it is adequately covered in the manufacturer's instructions.

9.4.6 All furnaces tested and certified for compliance with all of the provisions of

this standard shall be labeled and assigned a model number for each rating specified in paragraphs 9.3, 9.4.1, 9.4.2, 9.4.3, and 9.4.4, except as indicated in paragraph 9.4.5.

9.5 Multi-position furnaces shall be tested, rated and certified in each position specified by the manufacturer in his sales literature and installation instructions.

10. LABELING

10.1 Each furnace complying with the provisions of this Commercial Standard shall bear a permanent rust-proof plate or plates located so as to be easily read when the appliance is in a normally installed position, and on which shall appear the following:

(a) At top of plate the wording "Commercial Standard CS104-63 in a size and style of type corresponding to that on the cover page of the printed standard (12-point Franklin gothic), or larger type size.

(b) The manufacturer's or distributor's name (See par. 3.20.)

(c) Model number with Series or Serial Number assigned by the manufacturer or distributor.

(d) The bonnet capacity in B.t.u. per hour (See par. 9.1.)

(e) Firing rate in gallons per hour with CS12-48 No. . . . . oil equals $\frac{\text{B.t.u./hr.}}{140{,}000}$ input expressed to the nearest 0.05 gallon.

(f) The manufacturer's specified draft at furnace outlet in inches water gage.

(g) If the burner is not an integral part of the furnace, the make, model and type or number of the oil burner or burners with which the furnace has received approval shall be shown either on the above-mentioned rating plate or on another plate similarly attached to the furnace for the purpose.

The following item is to be added in all cases where the manufacturer wishes to certify either at an air temperature rise other than standard or at an external static pressure higher than that specified in 7.5.1, or both:

(h) Certified for operation at an air temperature rise of _____°F. at an external static pressure _____ in. water gage.

11. INSTALLATION REQUIREMENTS AND PERFORMANCE TESTS

11.1 Installation requirements. -

11.1.1 Size. - The furnace shall be of adequate size for the connected heating load.

11.1.2 Requirements. - The standard requirements as approved by the industry are:

(a) Firing rate. - The firing rate at which the burner is set shall not exceed the firing rate designated on the manufacturer's label affixed to the furnace.

(b) Draft. - An automatic draft regulator is required.

(c) CO2. - In order to determine gross efficiency and output, CO_2 should be measured with a suitable analyzer.

(d) Flue-gas temperature. - The flue-gas temperature shall be measured on the furnace side of the draft regulator and not more than 12-in. from the furnace flue-gas outlet. The flue-gas temperature shall be measured at the firing rate recorded on the rating plate and shall not exceed 900° F. for natural-draft burners or 800° F. for mechanical draft

burners.

(e) Smoke. - The smoke shall not exceed that corresponding to the No. 7 smoke on the Shell-Bacharach scale, or equivalent, after the burner has been in operation for 15 minutes.

(f) Manufacturer's instructions. - Each central furnace shall be accompanied by printed instructions and diagrams adequate for its proper field assembly, installation, and safe operation, including all controls and accessories. These instructions shall specify adequate clearance around air openings into the combustion chamber, clearances from and protection of combustion material, and provisions for accessibility, and for combustion and ventilating air supply. These instructions shall state that central furnaces, when used in connection with cooling units, shall be installed in parallel with or on the upstream side of the cooling units to avoid condensation in the heating element unless the furnace has been specifically approved for downstream installation. The instructions shall point out that with a parallel flow arrangement the dampers or other means used to control flow of air shall be adequate to prevent chilled air from entering the furnace, and, if manually operated must be equipped with means to prevent operation of either unit unless the damper is in the full heat or cool position.

If a forced-air furnace is tested at a temperature rise of 60° F., these instructions shall state that the installation is to be adjusted to obtain a rise of from 50° F. to 70° F. If a forced-air furnace is tested at a temperature rise of 85° F., these instructions shall state that the installation is to be adjusted to obtain a rise of from 70° F. to 105° F. If a forced-air furnace is tested at a temperature rise of 115° F., these instructions shall state that the installation is to be adjusted to obtain a rise of from 100° F. to 130° F.

The instructions shall state the location of sampling point and the procedure for making measurements to meet the foregoing requirements for measuring draft, CO_2, flue gas temperature and smoke.

11.2 Installation test procedure. -

11.2.1 Equipment. - The following equipment shall be available on each furnace-burner installation when the tests are started:

(a) Where the oil rate is not indicated on the fuel-control valve, a suitable device for determining the rate in terms of gallons per hour fed to the burner shall be used.

(b) A suitable flue-gas analyzer for determining the percentage of CO_2, in the flue gases.

(c) A suitable draft gage, graduated in hundredths of an inch of water.

(d) A suitable thermometer for determining the flue-gas temperature.

(e) A suitable smoke meter.

(f) Provisions for inserting a thermometer to indicate the flue-gas temperature, as follows: Not more than 12 inches from the furnace flue-gas outlet, measured on the centerline of the breeching, a hole not more than 1/2 in. in diameter shall be located at the side of the breeching on the centerline so that the thermometer may be inserted horizontally. The thermometer is to be placed so that the sensitive element is one-fourth of the pipe diameter from the near side of the breeching. The opening around the thermometer stem shall be sealed to prevent air leakage. This same opening may be used for checking draft and sampling flue gases.

11.2.2 Test procedure. - The test procedure shall be as follows:

(a) The furnace shall be operated and the fuel rate adjusted to comply with paragraph

11.1.2 (a).

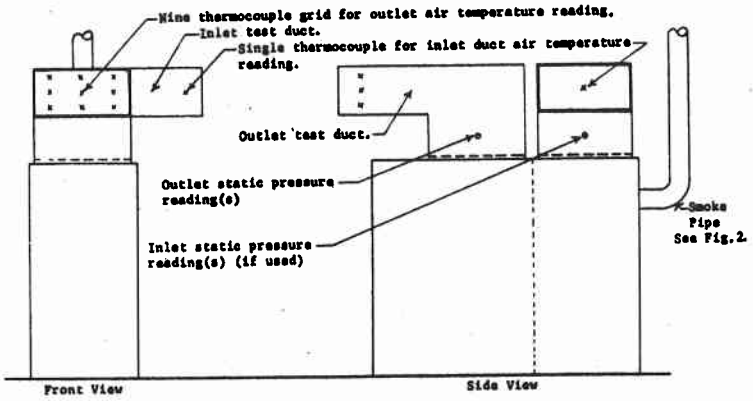
(b) The draft shall then be adjusted to comply with the manufacturer's recommendations.

(c) Combustion air adjustments shall then be made.

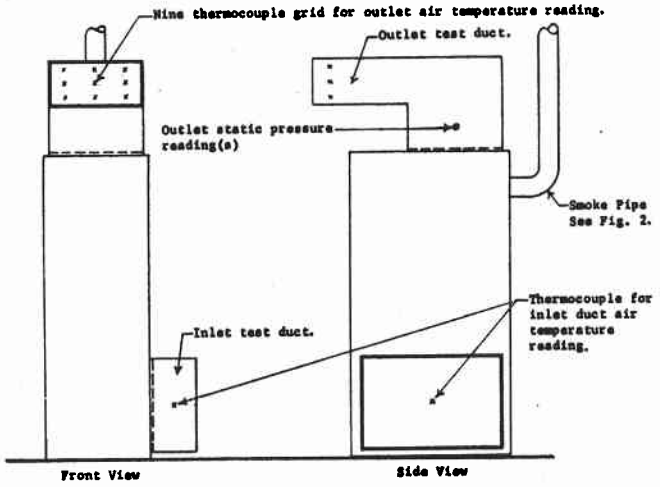
(d) The flue-gas temperature shall be recorded when the furnace has operated not less than 10 minutes at the recorded firing rate, and after the air temperature in the furnace bonnet has reached 125° F. with the heated air circulating through the duct system.

(e) The CO_2 shall be measured.

11.2.3 Readings. - During the period of operation, to permit flue-gas temperature to reach maximum, readings of draft, CO_2, and oil rate, if observed, shall be taken and the average recorded on the oil-burner furnace- burner unit certificate. All controls and limiting devices shall be checked for proper operation and the certificate checked that this has been done. The field test for smoke shall be made after the burner has been in operation for 15 minutes.

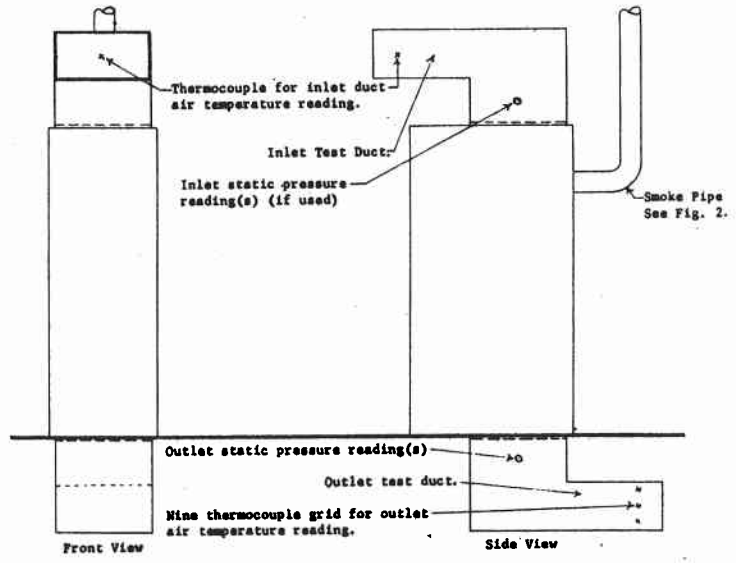


"A" UPFLOW FURNACE - BASEMENT TYPE

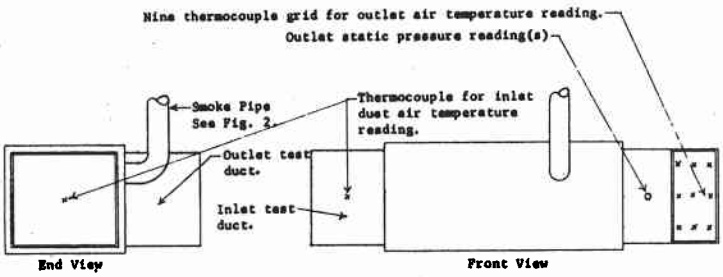


"B" UPFLOW FURNACE — UTILITY TYPE

FIGURE 1. SCHEMATIC DIAGRAMS SHOWING ARRANGEMENT OF APPARATUS FOR TESTING FORCED-AIR FURNACES.

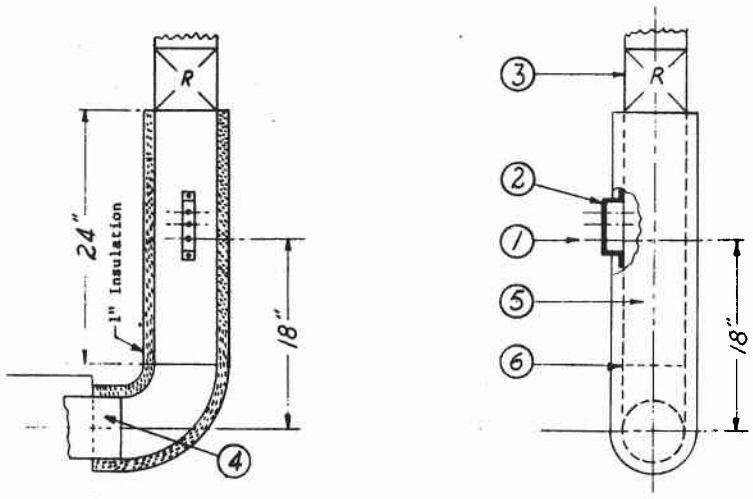


"C" DOWNFLOW FURNACE



"D" HORIZONTAL FURNACE

FIGURE 1. SCHEMATIC DIAGRAMS SHOWING ARRANGEMENT OF APPARATUS FOR TESTING FORCED-AIR FURNACES



1. Center line of thermocouple - See Figure 3.
2. Support bracket - See Figure 3.
3. Draft regulator.
4. Flue collar.
5. Section of smoke pipe, same nominal diameter as furnace flue collar.
6. Seal all openings in smoke pipe below gas-sampling tube.
7. Insulation to be mineral wool or equivalent.

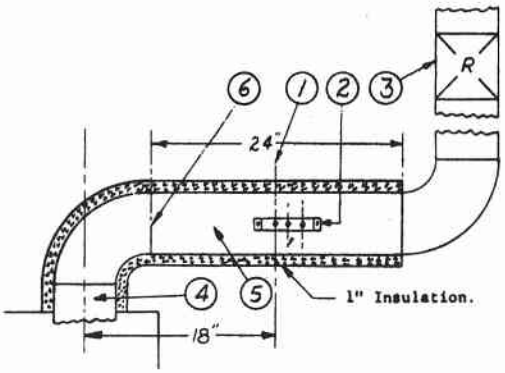
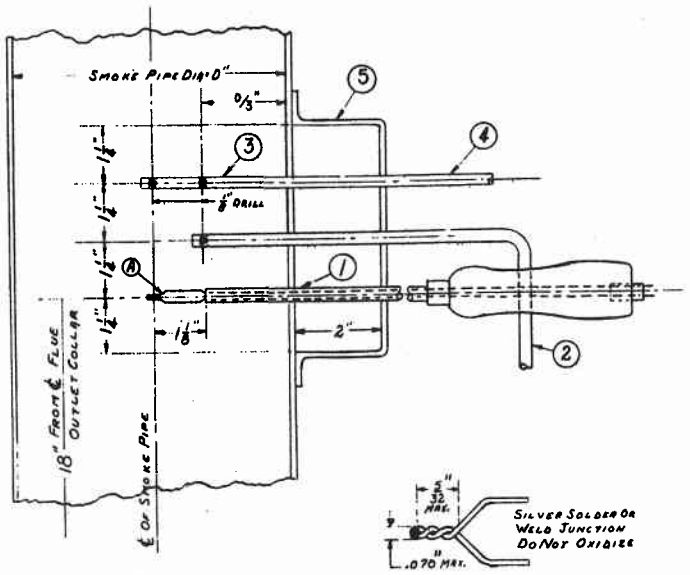


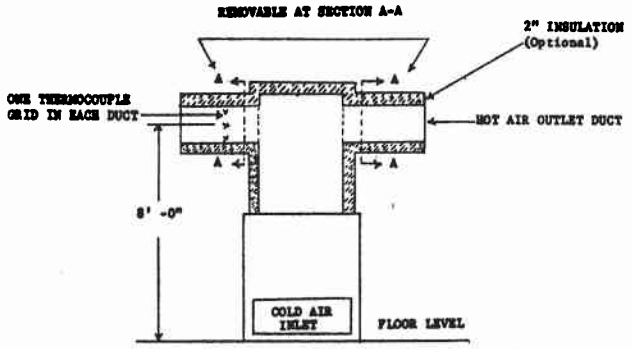
Figure 2. - Furnace Flue Connections.

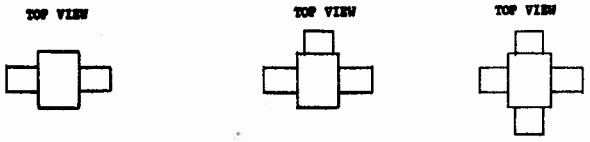


Ⓐ Detail of hot junction.

1. Standard thermocouple for flue gas temperature measurement.
2. Draft tube - 1/4" O.D.
3. Gas-sampling tube - 1/4" O.D. or
4. Bacharach Smoke Tester tube.
5. Support bracket.

FIGURE 3 – SUPPORT BRACKET ASSEMBLY, THERMOCOUPLE, DRAFT TUBE, GAS-SAMPLING AND SMOKE TESTER TUBE.





Input Rate- Btu Per Hr. 30,000-185,000

Input Rate 185,001- 277,000 Btu Per Hr.

Input Rate 277,001- 370,000 Btu Per Hr.

FIGURE 4. ARRANGEMENT OF HOT AIR OUTLET DUCTWORK FOR TESTING GRAVITY WARM AIR FURNACES

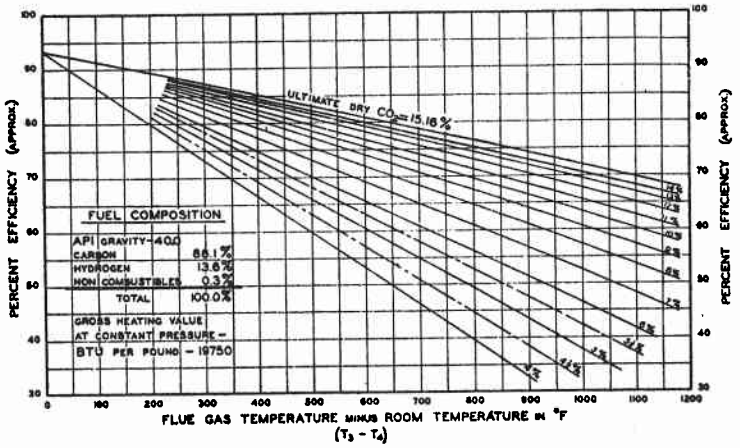


FIGURE 5A – EFFICIENCY CHART FOR WARM-AIR FURNACES EQUIPPED WITH VAPORIZING-TYPE BURNERS

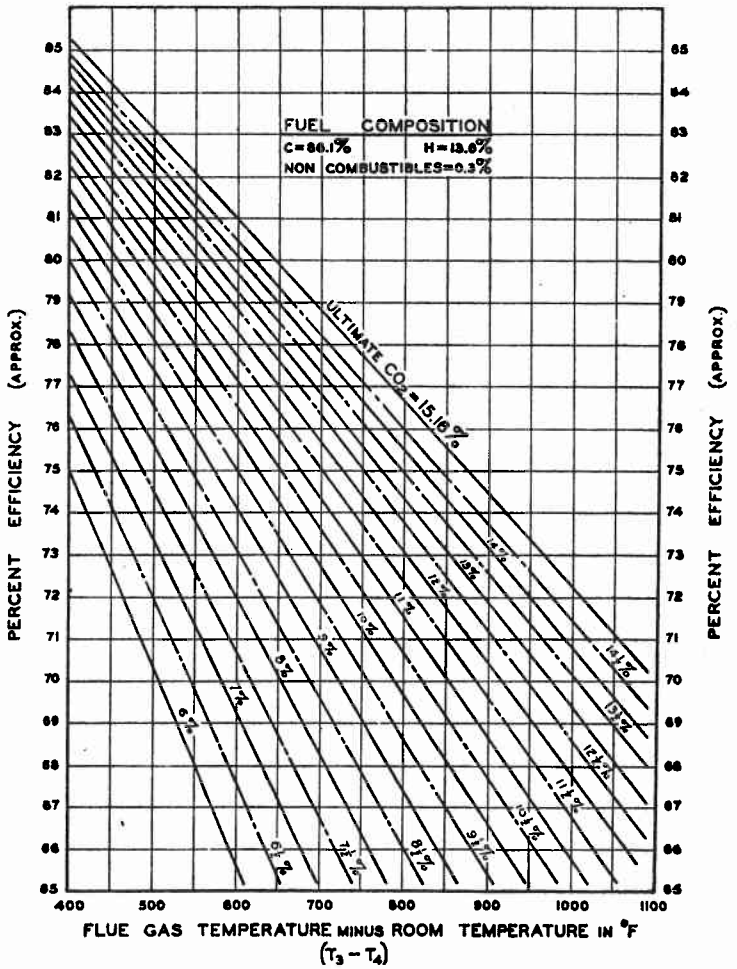


FIGURE 5B – ENLARGED EFFICIENCY CHART FOR WARM-AIR FURNACES EQUIPPED WITH VAPORIZING-TYPE BURNERS.

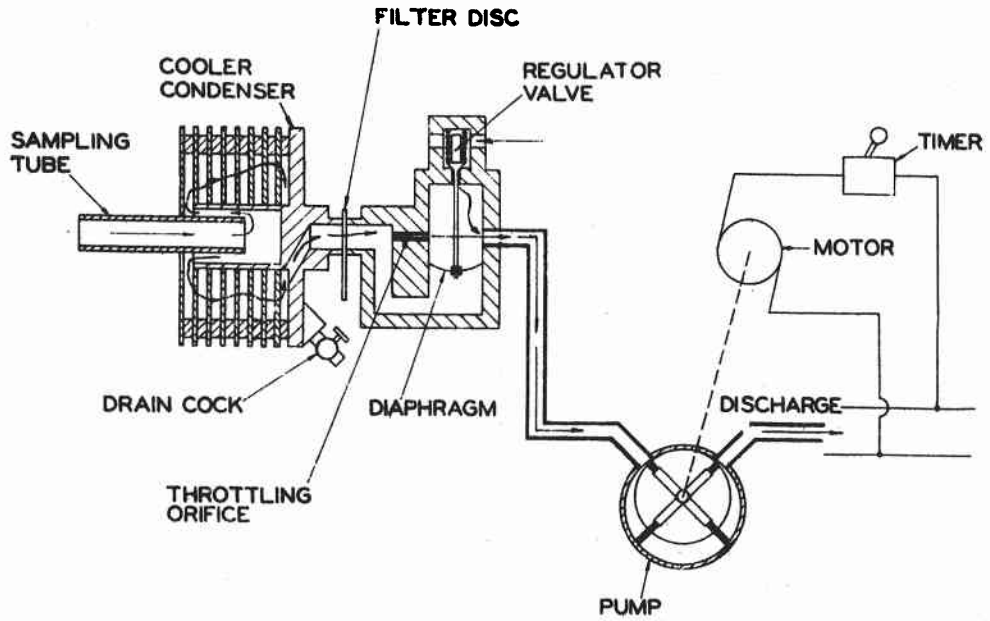


FIGURE 6. *Laboratory-type smoke meter.*

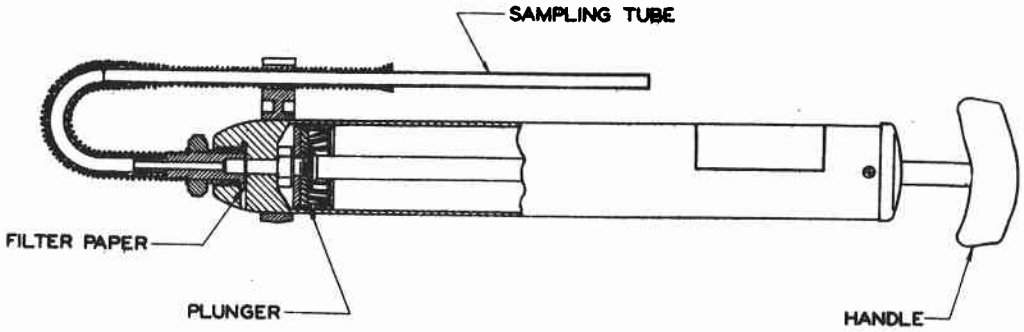


FIGURE 7. *Field-service-type smoke tester.*

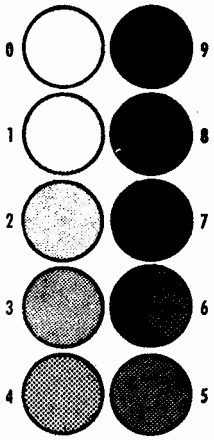


FIGURE 8. *Smoke scale for filter-paper method for determining smoke density in flue gases.*

(Caution: Above illustration is not a usable smoke scale.)

Test Data Sheet A
Test No._____

COMPUTED RATING TEST DATA
FORCED-AIR FURNACES OR GRAVITY FURNACES

Furnace_____Model No._____ Series or Serial No._____

Oil Burner_____Model No._____ Rating_____G.P.H.

*Furnace Blower_____Model No._____ Type of Drive_____

1. Heat Input (rated input desired).	BTU/hr._____
2. Standard A.P.I. Gravity of Fuel at 60° F. - See 7.4.1 and 7.4.3.	Degrees_____
3. Heat value of fuel - See 7.4.2.	BTU/gal._____
4. Oil burning test rate. (Item 1 divided by Item 3.)	G.P.H._____
5. Draft at furnace outlet.	In. W. G._____
6. Smoke meter indication. (Specify type meter) - See 7.3.8 to 7.3.14.	No._____
7. Flue gas temperature (T_3) less room temperature (T_4).	° F._____
8. Stack loss - See Figure 5.	%_____
9. Casing loss - See 7.6.4.	%_____
10. Bonnet output - See 7.6.1, 7.6.2 and 7.6.3.	%_____
*11. Outlet air temperature (T_2) less inlet duct temperature (T_1).	° F._____
*12. Net external static pressure.	In. W.G._____

NOMINAL (CATALOG) RATING DATA

Bonnet capacity - Forced-air (Item 1 times 0.80 to the nearest 1000 BTU).	BTU/hr._____
Bonnet capacity - Gravity (Item 1 times 0.75 to the nearest 1000 BTU).	BTU/hr._____
Firing rate - (Item 1 divided by 140,000 to the nearest 0.05 gal.)	G.P.H._____
CS12-48 grade of oil.	No._____
Specified Draft (not less than Item 5).	In. W.G._____
*External static pressure (not more than Item 12).	In. W.G._____
*Test air temperature rise (Item 11 ± 2%) - See Section 9.	°F._____
*Allowable operating range - See 11.1.2 (f) _____°F.	to _____°F.

*Not required for Gravity Furnaces.

Remarks

Tested by_____

Date_____

Test Data Sheet B
Test No._____

RECORDED RATING TEST DATA
FORCED-AIR FURNACES AND GRAVITY FURNACES

Test Fuel _____ CS12 #_____ Observed API Gravity _____ Degrees at _____ °F.

Furnace Blower Speed During Test_____ RPM

Electrical Input
to Blower Motor _____ Volts_____ Amps. Motor Nameplate H.P. _____

			Four readings at 20 min. intervals				Average
Fuel Oil Temperature.		°F.	_____	_____	_____	_____	_____
Fuel Input. Lbs/hr. or cc/min.			_____	_____	_____	_____	_____
Draft. See 7.5 (b) or 8.5 (b).	Ins.	W.G.	_____	_____	_____	_____	_____
Smoke Meter. See 7.5 (a) or 8.5 (d).		No.	_____	_____	_____	_____	_____
Flue Gas Temp. (T_3).		°F.	_____	_____	_____	_____	_____
CO_2 in flue gas.		%	_____	_____	_____	_____	_____
CO in flue gas. See 7.5 (e).		%	_____	_____	_____	_____	_____
*Gross Static Pressure., See 7.5.1 .	Ins.	W.G.	_____	_____	_____	_____	_____
Room Temperature (T_4), See 3.12		°F.	_____	_____	_____	_____	_____
*Inlet Duct Temperature, (T_1). See 3.8 or 7.2.9		°F.	_____	_____	_____	_____	_____
*Outlet Air Temperature, (T_2), Forced-Air. See 7.2 .		°F.	_____	_____	_____	_____	_____
Outlet Air Temperature, (T_2), Gravity. See 8.2 .		°F.	_____	_____	_____	_____	_____
No. 1 Outlet Duct (Right).		°F.	_____	_____	_____	_____	_____
No. 2 Outlet Duct (Left).		°F.	_____	_____	_____	_____	_____
No. 3 Outlet Duct (Rear).		°F.	_____	_____	_____	_____	_____
No. 4 Outlet Duct (Front)		°F.	_____	_____	_____	_____	_____

*Not required for Gravity Furnaces

REMARKS

TESTED BY_____

DATE_____

METHOD OF TEST
FORCED-AIR FURNACES OR GRAVITY FURNACES
(REFER TO SECTIONS 7 or 8)

The accurate determination of bonnet efficiency, air temperature rise through the furnace and external static pressure largely depends on the maintenance of equilibrium conditions during this test. Laboratory temperatures shall be regulated automatically or manually so that the maximum variation between individual room temperature (T_4) or inlet duct air temperature (T_1) readings shall not exceed 5°F. It is recommended that average laboratory temperature be no lower than 60° F. nor higher than 90° F., during all rating and performance tests. Test observations shall be recorded as indicated on Test Data Sheet B.

Room Temperature (T_4) shall be determined as specified in paragraph 3.12.

Outlet Air Temperature (T_2) shall be determined as specified in paragraph 3.9. In all cases where a number of thermocouples are wired in parallel in order to obtain a single average reading, the lengths of all thermocouple leads must be equal before paralleling.

Inlet Duct Temperature (T_1) applies to forced-air furnaces only and shall be determined as indicated in paragraph 3.8. The inlet test duct shall be as specified in paragraph 7.2.9, except that in the case of upflow or downflow type furnaces, with return air openings facing upward, a rectangular elbow must be used and so located that the plane of the inlet of the horizontal test duct shall be parallel to any side of the furnace casing other than that of the flue outlet. The horizontal portion of the test elbow shall extend at least 12 inches beyond the furnace casing or be of sufficient length to prevent the thermocouple from receiving direct radiation from any part of the heating surface or being less than 6 inches from the duct inlet.

At the option of the manufacturer, the arrangement and dimensions of outlet and inlet test ducts may conform to Figures 12, 13, and 14 as shown in Underwriters' Laboratories, Inc., Standard for Oil-Fired Central Furnaces, UL 727, October 1957 or subsequent revisions.

Gross Static Pressure is to be measured in the discharge plenum according to paragraph 7.3.4 when the furnace is operating against a minimum or optional external static pressure imposed by a restriction symmetrically applied at the end of the outlet test duct and shall include all additions specified in paragraph 7.5.1. In cases where the size or shape of the inlet test duct is such as to indicate an appreciable negative pressure at the furnace inlet, the manufacturer may, at his option, measure this negative static pressure and subtract it from that measured in the outlet test plenum.

If static pressure has to be varied for test purposes, it must be varied on the plus side.

Measurements shall be made as close as possible to the air supply and return openings (if used) of the furnace, and in all cases shall be made between the furnace openings and any restriction or elbows in the test plenum or ducts.

Net External Static Pressure is obtained by deducting from the gross static pressure measurement all additions made for furnaces tested without air filters or when tested with dry refrigeration coils in place.

It is recommended that two static pressure connections, connected in parallel, be made on opposite sides of both the discharge plenum and inlet test duct (if recorded) whenever rectangular elbows are used, in order to insure the accurate determination of external static pressure.

Air filter(s), as specified in paragraph 5.12 shall be available for all "safety standard" tests which are to be conducted so as to conform with all of the requirements of this standard.

Test Data Sheet C
Test No._____

AIR TEMPERATURE LIMIT CONTROL CUT-OUT TESTS

Forced Air Furnaces (Refer to paragraphs 5.13 and 9.4).

Method of Test

Adjustable temperature limit controls shall be set at the maximum temperature position (allowed by the fixed stop). The furnace shall be installed and allowed to operate as specified under 7.2 and 7.5 at equilibrium temperature. The furnace air inlet shall then be progressively blocked at a rate which will produce a warm air outlet temperature rise not in excess of 5° F. per minute. The outlet air temperature at limit control cut-out shall be recorded.

Gravity Furnaces (Refer to paragraph 5.13.2 and Figure 4.)

Method of Test

Adjustable temperature limit controls shall be set at a maximum temperature position (allowed by the fixed stop). The furnace shall be installed and allowed to operate as specified under 8.2 and 8.5 at equilibrium temperature.

A preliminary test shall be made to determine the degree of blocking of the cold air inlets required to produce the air temperature that will cause the limit control to function. The cold air inlet blockage shall then be relieved slightly and the furnace operated until substantially equilibrium outlet air temperature has been obtained. The cold air inlet shall then be gradually blocked over a period of 10 minutes until its effective area is reduced to 5 percent of the original area available before any blockage was introduced. The furnace shall then be operated until the limit control functions. The maximum outlet air temperature shall be measured at the outlet test duct registering the highest temperature.

Cut-out Temp.

Limit Control..... _____°F.
Make Model Type or No.

Specify Location

Tested By_____

Date_____

Test Data Sheet D
Test No._____

DOWNFLOW AND HORIZONTAL FORCED AIR FURNACES ONLY
Test for operation from a cold start
(See 6.3, 6.4, and 7.2.10)

A rectangular duct as specified in 7.2.10.1 for Downflow Furnaces and as specified in 7.2.10.2 for Horizontal Furnaces, shall be attached to the return air inlet of the furnace.

The limit control shall be adjusted to its maximum setting allowed by the fixed stop. If an additional auxiliary limit control of either the automatic recycling or manual reset type be provided, it must be included in the wiring circuit.

The fan control, if adjustable, shall be set at the maximum temperature specified by the manufacturer in his instructions or may be provided with a fixed stop.

The furnace shall be adjusted for operation as specified under 7.5 or under 9.4 and against a static pressure as specified by the manufacturer but not less than that required in 7.5.1.

Starting with furnace at room temperature, the furnace is to be fired and allowed to operate until the blower becomes operative. Blower must start and operate continuously before any temperature limit control functions except that an automatic cycling temperature limit control which also operates to start the blower may cycle once only.

Average room temperature and the temperature indicated by the three thermocouples at the return air opening of the furnace, just prior to the functioning of the fan control to circulate air in the normal direction, shall be recorded.

	TC-1	TC-2	TC-3
Temperature readings of thermocouples in return air inlet -- °F.	_____	_____	_____
Average room temperature reading ----------		°F.	_____

Record below Make, Type, Model Number and location of the fan control and auxiliary limit control (if used). Show the maximum temperature setting of the fan control specified in manufacturers' instructions or allowed by a fixed stop (optional) as well as the maximum temperature setting of an auxiliary limit control (if used) which, if adjustable, must be provided with a fixed stop.

REMARKS:

CASING LOSS
METHOD OF TEST
Forced-Air Furnaces or Gravity Furnaces
(Refer to 7.6.4)

Note: At the option of the manufacturer, this test need not be applied if a casing loss of 2.0% for forced-air furnaces and 5.0% for gravity furnaces be assumed by the manufacturer and recorded as Item 9 on Test Data Sheet A. This applies to all furnaces tested for Alcove or Closet installation as well as those tested for Standard Clearance installation according to Form 1 or Form II in Table III of UL 727.

Where a furnace is equipped with a "vestibule" (compartment enclosing or concealing burner and control equipment), the inside division panel (enclosing the heat exchanger) shall be considered as the front casing panel with surface temperatures measured with all front access panels of the "vestibule" removed.

In the case of a basement type forced-air furnace where the return air blower compartment also encloses secondary heating surface, the casing surface temperatures of such a compartment shall be measured. A flue pipe extension in this compartment not larger than the flue outlet at the heat exchanger shall not be considered as secondary heating surface.

Surface temperature measurements on the oil burner, burner mounting plate and inspection or access doors or panels may be omitted for the purposes of this test. Surface temperatures of the casing adjacent to these items shall be measured at points not less than 2-inches from the edges of each frame or panel.

Any casing panel at an angle of 45 degrees or less from the vertical shall be considered as a vertical surface.

An exposed flue collector (breeching) or flue outlet forming an integral part of the furnace shall not be included in casing surface temperature measurements

The casing loss of the furnace shall be determined by sub-dividing the casing into 6 inch squares and measuring the surface temperatures at the center of each square with a surface thermocouple. The areas of the 6 inch squares shall be recorded in groups in which the surface temperature difference between the 6 inch squares is less than 20° F. Should the area remaining be greater than 3 inch width at the edge of the casing, the temperature-area calculation should be accountable. If less than 3 inch width, it can be ignored.

The hourly heat loss through the casing shall be the sum of the hourly heating loss of each recorded group as computed from the formula:

$$H_s = (h_{rs} + h_c) A_s (t_s - T_4)$$

Where

H_s = hourly heat loss through casing in BTU/hr for each recorded group.

h_{rs} = coefficient of radiation for the surface BTU/hr/sq.ft/ °F.

h_c = coefficient of connection BTU/sq.ft./°F.

A_s = area of group sq. ft.

t_s = temperature of surface, °F.

T_4 = temperature of room, °F.

Test Data Sheet E
Test No._____

RECORDED AND COMPUTED CASING LOSS TEST DATA
Forced-Air Furnaces or Gravity Furnaces
$H_s = (h_{rs} + h_c)\ A_s\ (t_s - T_4)$

Room Temperature (T_4). (See 3.12) °F. Four readings at equal intervals _____ _____ _____ _____ Average _____

	t_s ± 10° F.	No. in Group	Sq.ft.	h_{rs}	h_c	$(h_{rs} + h_c)$	$(t_s - t_a)$	H_s BTUH
Vertical Surface	90							
	110							
	130							
	150							
	170							
	190							
	210							
	230							
	250							
Horizontal Surface (facing upward)	90							
	110							
	130							
	150							
	170							
	190							
	210							
	230							
	250							
Horizontal Surface (facing downward)	90							
	110							
	130							
	150							
	170							
	190							
	210							
	230							
	250							

TOTAL _____

Total H_s for all Vertical and Horizontal surface divided by Heat Input (Item 1 on Test Data Sheet A) multiplied by 100 = _____% casing loss (enter as Item 9 of Test Data Sheet A).

REMARKS:

Tested By_____
Date_____

Value of h_c for a recorded group may be found from the curves shown in Figure 9. Value of h_{rs} for a recorded group may be found in the Table shown in Figure 10 for a painted surface.

The percentage of casing loss shall be the hourly heat loss through the casing divided by the hourly input and multiplied by 100.

If adequate facilities are available, it will generally be found advantageous to record casing surface temperatures while conducting the rating test (Test Data Sheet B). At the option of the manufacturer, however, casing surface temperatures and average room temperature may be recorded during a separate test as long as all specified test conditions are maintained. Average room temperature (T_4) shall be determined by not less than four readings at approximately equal intervals during the test.

Inlet-air and room temperatures shall be regulated as specified in Test Data Sheet B (Method of Test).

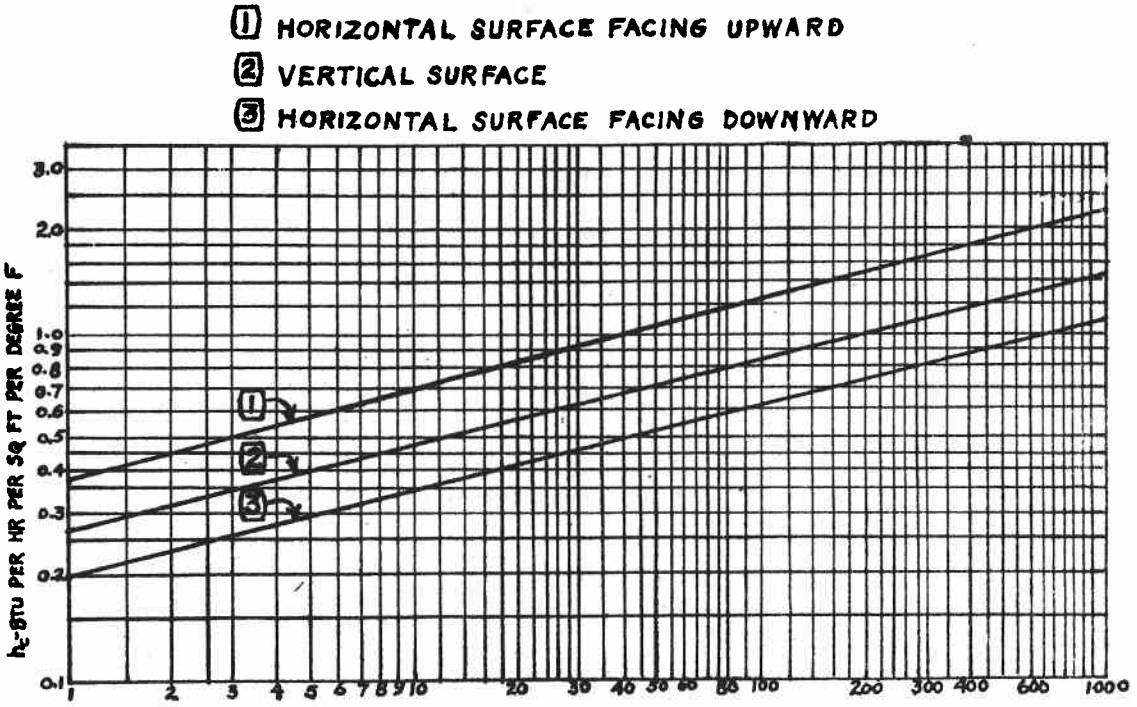


FIGURE 9. CONVECTION COEFFICIENTS FOR VERTICAL AND HORIZONTAL SURFACES

TABLE VALUES FOR h_{rs}

BTU Per Hr. Per Sq. Ft. Per Deg. F.

For a Painted Surface

Surface Temperature Deg. F.	Surrounding Air Temperatures Deg. F.			
	60	70	80	90
75	.90	.90		
100	.92	.93	.97	1.00
125	1.07	1.11	1.15	1.18
150	1.13	1.16	1.19	1.22
175	1.18	1.20	1.24	1.27
200	1.27	1.30	1.34	1.37
225	1.35	1.38	1.42	1.45
250	1.47	1.51	1.55	1.58
275	1.57	1.61	1.65	1.68
300	1.67	1.71	1.75	1.79
325	1.75	1.79	1.83	1.87
350	1.88	1.92	1.96	2.00

To obtain emissivity factor (hrs) for other materials, multiply above values by coefficients listed below.

Galvanized sheet iron, bright	.26
Galvanized sheet iron, oxidized	.32
Asbestos paper	1.07

Figure 10 - Coefficient of heat transfer on painted surfaces by radiation for emissivity of 0.87.

HISTORY OF PROJECT

At an informal meeting on July 14, 1941, a group of manufacturers recommended that a standard test code be established for warm-air furnaces equipped with vaporizing-type oil burners. A Commercial Standard was later drafted and on March 18, 1942, the cooperation of the National Bureau of Standards in its further preparation was requested.

The proposed standard was tentatively adopted by a conference of manufacturers on April 17, 1942, in Chicago, Illinois, and after considering suggestions from the industry, a revised draft was circulated on September 28, 1942, for industry consideration. General endorsement was given in statements of acceptance from representatives, producers, distributors and users, and on December 9, 1942, the standard was announced as CS104-43, effective January 1, 1943.

First revision. - Suggestions for revision were received from various sources in the trade, and a draft revision recommended by the Standing Committee was circulated under date of September 19, 1945 for industry consideration. The acceptances subsequently received were generally representative, and on February 19, 1946 the revised standard was announced as CS104-46, effective March 15, 1946.

Second revision. - The revision was proposed by the Federal Housing Administration to provide, among other items, a field test and a method of certification for the field performance of furnaces with vaporizing burners. Recommendations from manufacturers and the Standing Committee were included. After further consideration by the Standing Committee, a recommended revision was circulated on April 14, 1949 for industry consideration. The acceptances recorded were generally representative, and the revision was announced on August 15 as Commercial Standard CS104-49, effective September 15, 1949.

Third revision. - The Oil Division of the Institute of Appliance Manufacturers in June 1958 recommended a number of changes and subsequently cooperated in preparing a draft which was suitably coordinated with other Commercial Standards. After further development in cooperation with the IAM in 1959 and 1960, the proposed revision was circulated on September 18, 1961 to producers, distributors and users as an industry recommendation. It was subsequently given general endorsement by acceptors in representative industry organizations and on July 1, 1963 the revised standard was announced as CS104-63, effective August 1, 1963.

Project Manager: H. A. Bonnet, Office of Commodity Standards, National Bureau of Standards, U.S. Department of Commerce.

Technical Advisors: Selden D. Cole, Mechanical Systems Section, National Bureau of Standards, U.S. Department of Commerce.
Marc Resek, Institute of Appliance Manufacturers' Engineering Consultant.

STANDING COMMITTEE

The Standing Committee was being formed when this standard was published. The chief functions of the committee are to consider proposed revisions, and make recommendations for keeping the standard abreast of progress. Such changes are circulated for industry review and acceptance prior to adoption and issue.

Comments on the standard and suggestions for revision may be referred to a member of the committee or to the Office of Commodity Standards, National Bureau of Standards, U.S. Department of Commerce, which acts as secretary for the committee. Further information on the committee may be obtained from the Office of Commodity Standards.

ACCEPTORS

The manufacturers, distributors, users, and others listed below have individually indicated in writing their acceptance of this Commercial Standard prior to its publication. The acceptances indicate an intention to utilize the Standard as far as practicable, but reserve the right to depart from it as may be deemed desirable. The list is published to show the extent of recorded public support for the Standard, and should not be construed as indicating that all products made by the acceptors actually comply with its requirements.

Products that meet all requirements of the standard may be identified as such by a certificate, grade mark or label. Purchasers are encouraged to require such specific representation of compliance, which may be given by the manufacturer whether or not he is listed as an acceptor.

ASSOCIATIONS
(General Support)

American Institute of Architects, Washington, D.C.
American Specification Institute, Chicago, Ill.
Institute of Appliance Manufacturers, Washington, D.C.
National Oil Fuel Institute, Inc., New York, N.Y.

FIRMS AND OTHER INTERESTS

Brookley Air Force Base, Service Engineering Division, Non-Aeronautical Branch, Mobile, Ala.
Brust & Brust, Architects, Milwaukee, Wis.

Century Engineering Corp., Cedar Rapids, Iowa.

Detroit, University of, Detroit, Mich.

Evans Products Co., Plymouth, Mich.

Flannagan, Eric G., and Sons, Architects & Engineers, Henderson, N.C.

Hovland Sheet Metal, Inc., Eau Claire, Wis.

International Oil Burner Co., St. Louis, Mo.

Lau Blower Co., The, Dayton, Ohio (General Support).

Mann & Co., Architects & Engineers, Hutchinson, Kans.
Marc Resek Research & Development, Inc., Shaker Heights, Ohio (General Support).
Martino, A. R., Co., Waterbury, Conn.
McPherson Furnace and Equipment Co., Seattle, Wash.

Preway Inc., Wisconsin Rapids, Wis.

Sears, Roebuck and Co., Chicago, Ill.
Staub, Rather and Howze, Architects, Houston, Tex. (General Support).
Stewart-Warner Corp., Heating & Air Conditioning Division, Lebanon, Ind.

Underwriters' Laboratories, Inc., Chicago, Ill. (General Support).

Welch, Carroll E., Architect, Huntington, N.Y.

U.S. GOVERNMENT

Department of the Army, Office of Chief of Engineers, Standardization Branch, Technical Services Division, Research & Development, Washington, D.C.

Department of Health, Education and Welfare, Procurement & Supply Management Branch, Washington, D.C.

Housing and Home Finance Agency, Public Housing Administration, Washington, D.C.

Veterans Administration, Washington, D.C.

ACCEPTANCE OF COMMERCIAL STANDARD

CS104-63 Warm-Air Furnaces Equipped With Vaporizing-Type Oil Burners

If acceptance has not previously been filed, this sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this Commercial Standard.

Date_____

Office of Commodity Standards
National Bureau of Standards
U.S. Department of Commerce
Washington, D.C. 20234

Gentlemen:

We believe that this Commercial Standard constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the

production[1] distribution[1] purchase[1] testing[1]

of this commodity.

We reserve the right to depart from the standard as we deem advisable.

We understand, of course, that only those articles which actually comply with the standard in all respects can be identified or labeled as conforming thereto.

Signature of authorized officer _____
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer_____

Organization_____
(Fill in exactly as it should be listed)

Street address_____

City, State, and ZIP code_____

[1] Underscore the applicable words. Please see that separate acceptances are filed for all subsidiary companies and affiliates which should be listed separately as acceptors. In the case of related interest, trade associations, trade papers, etc., desiring to record their general support, the words "General Support" should be added after the signature.

TO THE ACCEPTOR

The following statements answer the usual questions arising in connection with the acceptance and its significance:

1. Enforcement. - Commercial Standards are commodity specifications voluntarily established by mutual consent of those concerned. They present a common basis of understanding between the producer, distributor, and consumer and should not be confused with any plan of governmental regulation or control. The United States Department of Commerce has no regulatory power in the enforcement of their provisions, but since they represent the will of the interested groups as a whole, their provisions through usage soon become established as trade customs, and are made effective through incorporation into sales contracts by means of labels, invoices and the like.

2. The acceptor's responsibility. - The purpose of Commercial Standards is to establish, for specific commodities, nationally recognized grades or consumer criteria, and the benefits therefrom will be measurable in direct proportion to their general recognition and actual use. Instances will occur when it may be necessary to deviate from the standard and the signing of an acceptance does not preclude such departures; however, such signature indicates an intention to follow the standard, where practicable, in the production, distribution, or consumption of the article in question.

3. The Department's responsibility. - The major function, performed by the Department of Commerce in the voluntary establishment of Commercial Standards on a nationwide basis in fourfold: First, to act as an unbiased coordinator to bring all interested parties together for the mutually satisfactory adjustment of trade standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to canvass and record the extent of acceptance and adherence to the standard on the part of producers, distributors, and users; and fourth, after acceptance, to publish and promulgate the standard for the information and guidance of buyers and sellers of the commodity.

4. Announcement and promulgation. - When the standard has been endorsed by a satisfactory majority of production or consumption in the absence of active, valid opposition, the success of the project is announced. If however, in the opinion of the standing committee or of the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

USCOMM-NBS-DC

CS104-63

FEDERAL REGISTER

DEPARTMENT OF COMMERCE

National Bureau of Standards

VOLUNTARY PRODUCT STANDARDS

Notice of Intent To Withdraw Certain Standards

In accordance with § 10.12 of the Department of Commerce Procedures for the Development of Voluntary Product Standards (15 CFR Part 10, as revised, 35 F.R. 8349 dated May 28, 1970), notice is hereby given of the Department's intent to withdraw the 62 standards identified below. It has been tentatively determined that each of these Commercial Standards (CS) and Simplified Practice Recommendations (SPR) are obsolete, no longer technically adequate, no longer generally acceptable to and used by the industry, inconsistent with established policy, or otherwise inappropriate, and revision is not feasible or would serve no useful purpose.

CS 14–51 Boys' Sport and Dress Shirt (Woven Fabrics) Size Measurements.
CS 33–43 Knit Underwear (Exclusive of Rayon).
CS 56–60 Strip Oak Flooring.
CS 70–41 Phenolic Disinfectant (Emulsifying Type).
CS 71–41 Phenolic Disinfectant (Soluble Type).
CS 90–58 Power Cranes and Shovels.
CS 101–63 Flue-Connected Oil-Burning Space Heaters and Recessed Heaters with Vaporizing Pot-Type Burners.
CS 104–63 Warm-Air Furnaces Equipped with Vaporizing-Type Oil Burners.
CS 106–57 Boys' Pajama Sizes (Woven Fabrics).
CS 109–44 Solid-Fuel-Burning Forced-Air Furnaces.
CS 111–43 Earthenware (Vitreous-Glazed) Plumbing Fixtures.
CS 113–63 Oil-Burning Floor Furnaces Equipped with Vaporizing Pot-Type Burners.
CS 128–52 Men's Sport Shirt Sizes-Woven Fabrics (Other than Those Marked with Regular Neckband Sizes).
CS 129–47 Materials for Safety Wearing Apparel.
CS 131–46 Industrial Mineral Wool Products, All Types—Testing and Reporting.
CS 134–46 Cast Aluminum Cooking Utensils (Metal Composition).
CS 135–46 Men's Shirt Sizes (Exclusive of Work Shirts).
CS 145–47 Testing and Rating Hand-Fired Hot Water Supply Boilers.
CS 152–48 Copper Naphthenate Wood Preservative (Spray, Brush, Dip Applications).
CS 158–49 Model Forms for Girls' Apparel.
CS 165–50 Zinc Naphthenate Wood Preservative (Spray, Brush, Dip Applications).
CS 174–41 140-F Drycleaning Solvent.
CS 177–62 Bituminous-Coated Metal Septic Tanks (Residential).
CS 178–51 Testing and Rating Ventilating Fans (Axial and Propeller Types).
CS 180–52 Model Forms for Boys' Apparel.
CS 183–51 Boys' Trouser Size Measurements.
CS 185–52 Wool Felt.
CS 186–52 Boys' Sport Outerwear Size Measurements.
CS 195–60 Warm-Air Furnace Burner Units Equipped with Pressure-Atomizing or Rotary Type Oil Burners.
CS 196–55 Model Forms for Toddlers' and Children's Apparel.
CS 198–55 Infants', Children's, Girls' and Boys' Knit Underwear (Exclusive of Rayon, Acetate, and Nylon).
CS 216–58 Asphalt Insulating Siding.
CS 235–61 Pressure Treated Wood Fence Posts (With Oil-Type Preservatives).
CS 249–62 Pressure-Treated Douglas Fir Marine Piles.
CS 250–62 Pressure-Treated Southern Pine Marine Piles.
CS 271–65 Grading of Abrasive Grain for Grinding Wheels.
SPR 17–47 Heavy Forged Hand Tools.
SPR 44–49 Boxboard Thicknesses.
SPR 60–55 Machine, Carriage and Lag Bolts, and Nuts (Case Quantity and Gross Weight).
SPR 72–27 Solid Section Steel Windows.
SPR 77–45 Hickory Handles.
SPR 100–47 Welded Chain.
SPR 125–31 Waxed Tissue Paper.
SPR 136–32 Flax and Hemp Twine.
SPR 147–42 Wire Diameters for Mineral Aggregate Production Screens.
SPR 157–50 Steel Firebox Boilers and Steel Heating Boilers (Commercial and Residential).
SPR 163–48 Coarse Aggregates (Crushed Stone, Gravel, and Slag).
SPR 168–37 Braided Shoe Laces.
SPR 180–41 Copper Conductors for Building Purposes.
SPR 183–46 Brass or Bronze Valves (Gate, Globe, Angle, and Check).
SPR 184–47 Iron Valves (Gate, Globe, Angle, and Check).
SPR 185–47 Pipe Fittings (Gray Cast-Iron, Malleable Iron, and Brass or Bronze).
SPR 190–42 Stove Pipe and Accessories.
SPR 198–50 Wire Rope.
SPR 207–60 Pipes, Ducts, and Fittings for Warm Air Heating and Air-Conditioning Systems.
SPR 214–55 Metal-Cutting Band Saws (Hard Edge Flexible Back).
SPR 220–46 Open-End and Box Wrenches.
SPR 227–47 Plumbing Fixture Fittings and Trim for Housing.
SPR 229–63 Vises (Machinists' and Other Bench-Mounted Vises).
SPR 238–50 Convectors.
SPR 245–51 Weldless Chain and Chain Products.
SPR 259–56 Hexagon-Head Cap Screws (Case Quantity and Gross Weight).

Any comments or objections concerning the intended withdrawal of any of these standards should be made in writing and directed to the Office of Engineering Standards Services, National Bureau of Standards, Washington, D.C. 20234, within 45 days of the publication of this notice. The effective date of withdrawal, where appropriate, will be not less than 60 days after the final notice of withdrawal. Withdrawal action terminates the authority to refer to a published standard as a voluntary standard developed under the Department of Commerce procedures, from the effective date of the withdrawal.

Dated: June 16, 1972.

LAWRENCE M. KUSHNER,
Acting Director.

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